Discovering Innovative Ways to Reduce Diesel Engine Emissions

Argonne National Laboratory addresses technical barriers to reducing exhaust emissions from diesel engines by developing advanced emissions control technologies and gaining detailed knowledge of diesel fuel spray fluid mechanics and diesel particulate formation.

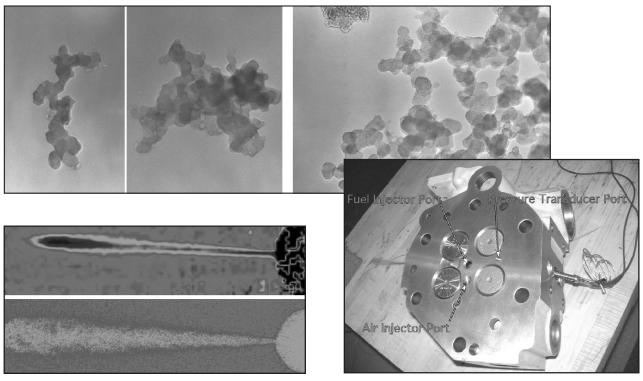
Lowering Nitrogen Oxides and Particulate Emissions

In a cooperative research and development agreement (CRADA) with Caterpillar, Inc., Argonne engineers are working to lower both nitrogen oxides (NO_x) emissions and particulate matter (PM) in diesel engine exhaust by modifying in-cylinder combustion processes. The patented technology injects air directly into the cylinder late in the combustion cycle to enhance soot oxidation. Combined with an optimized fuel-injection strategy, it also provides opportunities for simultaneous NO_x reduction.

Under another CRADA with a major truck manufacturer, Argonne staff is developing a clean alternative to exhaust gas recirculation (EGR): nitrogen-enriched air generated with a permeable membrane. The membrane, about the size of an air filter, supplies a stream rich in nitrogen for engine combustion. In diesel-fueled vehicles, increasing the nitrogen flow to the engine potentially reduces nitrogen oxide emissions without the problems caused by EGR.

For more information about the Caterpillar CRADA, contact Roger Cole, phone: (630) 252-6245, or Doug Longman (630) 252-4257.

For more information about the membrane CRADA, contact Steve McConnell (630) 252-3080.



Argonne employs novel approaches to reduce exhaust emissions, use x-rays to gain insight into engine performance, and understand the formation of diesel particulates.

Enabling Diesel Fuel Spray Breakthroughs

New x-ray techniques and equipment, used in tandem with conventional experimental methods, are providing extraordinary new findings in diesel engine performance, dynamics, emissions, structural integrity, and materials aspects. Argonne is conducting x-ray-based research on fuel sprays using pressurized spray chambers in Argonne's Advanced Photon Source beam line. Researchers, working with Bosch Injector, used x-rays to observe the first quantitative measurement of a shock wave in diesel fuel spray produced by a liquid penetrating into a gas. More detailed knowledge of spray fluid mechanics will lead to increased predictability of diesel combustion and allow manufacturers to precisely tune injection systems to meet stringent emissions standards.

For more information, contact Sreenath Gupta, phone: (630) 252-6089, or Steve Ciatti (630) 252-5635.

Understanding Diesel Particulate Formation

To better understand the formation and potential health impacts of diesel particulates, Argonne researchers are compiling detailed technical data on particulate morphology, microstructure, and chemistry in partnership with the University of Illinois at Chicago and Drexel University. Argonne has developed a thermophoretic sampling system to accurately measure nano-sized diesel particulates. A portable instrument, the TG1, facilitates diesel exhaust particulate measurement in real time. Based on a technique called laser-induced incandescence, it has been proven to perform better and provide a much faster response to transients than the comparable, conventional instrument.

For more information, contact Kyeong Lee (630) 252-9403 about research on particulate morphology or Sreenath Gupta (630) 252-6089 about the TG1 instrument.

For information on Argonne's entire diesel engine research program, contact Raj Sekar, phone: (630) 252-5101.

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